Jet Interaction Effect of Ares I Launch Vehicle Roll Control System
Exploration Systems Mission Directorate

Researchers at NASA Langley Research Center have created a database to quantify rolling moment and control uncertainties used for developing the Ares I launch vehicle's roll control system (RoCS). Databases of rolling moment coefficients, as well as jet and free-stream interaction effects of the Ares I RoCS in flight, are important for analyses of the guidance, navigation and control (GN&C) system throughout the vehicle's ascent phase.
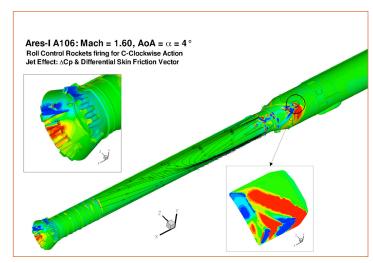
This work involves the creation of an aerodynamic database from 220 computational fluid dynamics (CFD) test cases for the Ares I (A106 configuration) RoCS jet interaction effect. The database was built in a three-month timeframe—using CFD alone—to meet the GN&C project deadline. The availability of NASA's supercomputers, storage, and high-speed networks was crucial to the feasibility of this work, as obtaining experimental data would have been technically complex and time consuming.

Project work includes: establishing flow conditions and constructing an optimized run matrix; computing flow solutions for RoCS jets both at idle and in action; analyzing the force and moment coefficient increments for all cases and examining flow physics details of selected cases; and interpolating the computed results at 220 discrete flow conditions.

This work represents an increase in scalability of the best-known NASA CFD codes to a level commensurate with industrial expectations in both speed and quality.

S. Paul Pao, NASA Langley Research Center
s.p.pao@nasa.gov

Sample result for RoCS effects at Mach=1.60 and angle-of-attack=4°: differential pressure coefficient and skin-friction vector trace. *S. Paul Pao, NASA/ Langley*